Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the above-identified application.

Listing of Claims

1. **(Currently amended)** A computer-implemented method comprising:

optimizing a multivariate representation of resources using multiple single-variable optimizations, wherein the resources are used in producing a set of products, and the resources, the set of products and their respective connectivities are represented in a product space plan, the optimizing comprising

converting a non-linear expected value function associated with the resources and products into a closed form expression;

transforming the product space plan into a working transformed space plan, wherein the products are transformed into working elements;

performing a loading step to form elemental blocks as a function of a single variable of the multivariate representation with elements being loaded with resources that gate production of the element;

examining the elemental blocks to determine if a first element has not been loaded with a corresponding first resource that gates production of the first element;

if the examining indicates that the first element has not been loaded with the first resource, performing a re-loading step to form elemental blocks as a function of a single variable of the multivariate representation with the first element being reloaded with the first resource;

solving for the maximum of each elemental block over each associated single variable of the multivariate representation, wherein the solving is performed by a computer; and

determining and presenting the optimum level of resources as a function of the solved for maximums.

2. (Original) The method of Claim 1, wherein the loading and re-loading steps result in an equilibrium configuration that provides the minimum amount of resources to produce any given amount of products across the whole plan.

3. (Original) The method of Claim 1, wherein the loading step further includes:
sequentially looking at each present working element;
determining if each associated resource gates production of the element,
if gating occurs, then unloading the resource from a prior element if so loaded, and
loading the resource onto the present element.

4. (Original) The method of Claim 3, wherein the reloading step further includes:
sequentially looking at each present working element;
reloading each unloaded resource back onto the element;
redetermining if the element is gated by each reloaded resource;
if the element is so gated, then merging the elements sharing each gating resource into a common elemental block which is a function of a single variable.

5. (Original) The method of Claim 3, wherein step of determining that gating occurs includes calculating a new maximum for the loaded element and determining if any remaining components further gate the maximum.

6. (Original) The method of Claim 4, wherein step of redetermining that gating occurs includes recalculating a new maximum for the reloaded element and determining if any remaining components further gate the maximum.

7. (Original) The method of Claim 4, wherein the step of merging the elements results in an elemental block that is a sub-plan of the overall plan, but which is a function of a single variable.

8. (Original) The method of Claim 7, wherein the merged elements intersect at a common resource in the transformed space.

9. (Previously Presented) The method of Claim 1, wherein the non-linear expected value function represents a statistical expectation of the value function at a given resource allocation and for a given demand distribution.

10. (Original) The method of Claim 1, wherein the transforming step involves taking a transformation of the product space to provide the working transformed space wherein the distribution induced on the resources is transformed into a distribution with zero mean and unit variance.

11. (Original) The method of Claim 10, wherein the transformation includes an inverse Cholesky transformation of the product space to provide the working transformed space.

12. **(Currently amended)** A computer-implemented method comprising:

optimizing a multivariate non-linear expected value function using multiple single-variable optimizations, wherein the multivariate non-linear expected value function represents a statistical expectation of the non-linear expected value function at a given component allocation and for a given demand distribution, the optimizing comprising

forming a plan in the product space associated with the non-linear expected value function which represents the products, components, and connectivities therebetween;

transforming the product space plan to form a corresponding working space plan, with products corresponding to elements such that the distribution induced on the resources is transformed into a distribution with zero mean and unit variance;

converting the associated non-linear expected value function into a closed from expression;

performing a loading step which loads each element with components that gate the production of each element, wherein the loading step forms elemental blocks as a function of a single variable of the multivariate non-linear expected value function;

examining the elemental blocks to determine if a first element has not been loaded with a corresponding first component that gates the production of the first element;

if the examining indicates that first element has not been loaded with the first component, unloading the first component and performing a reloading step that reloads the first element with the first component, wherein the reloading step forms elemental blocks as a function of a single variable of the multivariate non-linear expected value function;

merging elements that are further gated by components that were unloaded, with the loading, reloading, and merging steps resulting in an equilibrium configuration; [[and]]

solving the equilibrium configuration to determine the optimization of the non-linear expected value function, wherein the solving is performed by a computer; and

presenting the optimization of the non-linear expected value function.

13. (Original) The method of Claim 12, wherein the demand distribution includes any multivariate demand distribution that is a member of the elliptical family of distributions.

14. (Original) The method of Claim 13, wherein the multivariate demand distribution includes a multivariate normal distribution.

15. (Original) The method of Claim 12, wherein the transforming step includes using an inverse Cholesky transform.

16. (Original) The method of Claim 12, wherein the loading step includes:
sequentially analyzing each element in the plan;
determining if each associated component gates production of the element,
if gating occurs, then unloading the component from a prior element if so loaded, and
loading the component onto the present element.

17. (Original) The method of Claim 16, wherein the reloading step further includes:
sequentially analyzing each element in the plan;
reloading each unloaded component back onto the element;
redetermining if the element is gated by each reloaded component.

18. (Original) The method of Claim 12, wherein the equilibrium configuration includes configuring of the plan into elemental blocks which are a function of a single variable.

19. (Original) The method of Claim 18, wherein each elemental block is maximized over this single variable.

20. (Original) The method of Claim 19, wherein the optimum level of components to support the maximizations are derived from the maximized elemental values.

21. **(Currently amended)** A computer-implemented method comprising:

optimizing a multivariate representation of an amount of refinements produced from a level of resources, the optimizing using multiple single-variable optimizations and comprising

configuring the refinements and resources in a representative refinement space plan that accounts for connectivities therebetween;

deriving a non-linear expected value function for the refinement space plan;

converting the non-linear expected value function to a closed form expression;

transforming the refinement space plan into a working space plan, with the refinements represented by transformed elements;

sequentially loading each element with resources that gate the production of each element, wherein the each element is described by a single variable of the closed form expression;

sequentially examining each element to determine if an element has not been loaded with a corresponding resource that gates the production of the element;

if the examining of a first element indicates that the first element has not been loaded with a corresponding first resource that gates the production of the first element, unloading the first resource and reloading the first element with the first resource;

merging elements that are further gated by components that were unloaded, with the loading, reloading, and merging steps resulting in an equilibrium configuration; [[and]]

solving the equilibrium configuration to determine the optimization of the non-linear expected value function, wherein the solving is performed by a computer; and

presenting the optimization of the non-linear expected value function.

22. (New) A computer-implemented method comprising:

receiving a relationship between a output value and a plurality of variables, wherein the plurality of variables comprise:

a set of refinement quantities, wherein each refinement quantity corresponds to one refinement among a plurality of refinements, and generation of each refinement among the plurality of refinements requires at least one corresponding resource among a plurality of resources;

receiving statistical information regarding the refinement quantities;

transforming the set of refinement quantities in response to the statistical information to generate a set of transformed refinement quantities;

for each transformed refinement quantity among the set of refinement quantities:

identifying at least one gating resource, among the plurality of resources, that limits the transformed refinement quantity,

in response to the identifying, constructing a single-variable relationship between a constituent of the output value and a single variable, wherein the constituent of the output value, the single-variable relationship, and the single variable correspond to the transformed refinement quantity, and

optimizing the constituent of the output value based on the single-variable relationship; and

generating output data based on the optimizing the constituents of the output value, wherein the output data is usable in optimizing the output value.

23. (New) The method of Claim 22, wherein:

the refinements comprise at least one of: manufacturing products, financial assets, work tasks, energy products, or real estate products;

the resources comprise at least one of: manufacturing components, liquid capital, manpower resources, energy resources, or real estate resources;

the output value is an expected value of the refinements;

the statistical information describes demand for the refinement quantities; and

the output data comprises a set of prescribed refinement quantities for the plurality of refinements.

24. (New) The method of Claim 23, wherein the output data comprises a set of prescribed quantities of resources for the plurality of resources, and the optimizing the constituent of the output value comprises determining one or more of: (i) an optimal value of the constituent of the output value, or (ii) a value of the single variable that provides an optimization of the constituent of the output value.

25. (New) The method of Claim 22, wherein the relationship between the output value and the plurality of variables comprises a sum of products of univariate integrals, each with a closed form solution.

26. (New) The method of Claim 22, wherein the relationship between the output value and the plurality of variables comprises a sum of products of margin and demand for each refinement.

27. (New) The method of Claim 22, wherein the relationship between the output value and the plurality of variables comprises a function comprising terms dependent on the refinement quantities, and the statistical information comprises (i) estimates of demand for the refinement quantities and (ii) uncertainty in the demand for the refinement quantities.

28. (New) The method of Claim 22, wherein the relationship between the output value and the plurality of variables comprises a closed-form expression for an expected value function.

29. (New) The method of Claim 22, further comprising:
generating, from the relationship between the output value and the plurality of variables, a closed-form expression for an expected value function.

30. (New) The method of Claim 22, wherein the statistical information comprises means and a covariance matrix that relate to the quantity of components, and the transforming relates to a transformation that changes the means to zero and that diagonalizes the covariance matrix.

31. (New) The method of claim 1, wherein the presenting consists of storing, in a memory, the optimum level of resources as a function of the solved for maximums.

32. (New) The method of Claim 1, wherein the transforming step involves taking a transformation of the product space to provide the working transformed space wherein the distribution induced on the resources is transformed into a distribution with a diagonal covariance matrix.